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EXAMINER	
BARTON, JEFFREY THOMAS	
ART UNIT	**PAPER NUMBER**
1753	

DATE MAILED: 12/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/056,944	SANTIAGO ET AL.	
	Examiner	Art Unit	
	Jeffrey T. Barton	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 September 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-40* is/are pending in the application.

4a) Of the above claim(s) *29-40* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2 and 4-28* is/are rejected.

7)☒ Claim(s) *3* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *20050630*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The amendment filed on 19 September 2005 does not place the application in condition for allowance.

Status of Objections and Rejections Pending Since the Office Action of 9/20/2004

2. The objection to the specification is withdrawn due to Applicant's amendment.

3. The objection to claim 21 is withdrawn due to Applicant's amendment.

4. All rejections relying on Bek et al as a teaching reference are withdrawn due to Applicant's arguments.

5. All other rejections are maintained.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 5-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The recitation "further comprises a mixing chamber" in line 3 of the claim is in indefinite, since a mixing chamber was already recited in claim 1. It is not clear whether an additional mixing chamber is required.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

9. Claims 1, 2, and 15 are rejected under 35 U.S.C. 102(e) as being anticipated by Ahn et al.

Addressing claim 1, Ahn et al disclose an electrokinetic mixing method for rapid mixing of an initially heterogeneous solution (Paragraphs 0010 and 0011) whose motion is dominated by viscous forces (Microfluidic devices typically operate in this regime - low velocities, small length scales.), said method comprising: inducing an electrokinetic flow instability with an AC electric field within a mixing chamber. (Paragraphs 0050, 0062-0064; the channel itself can be considered a "mixing chamber") This AC field acts as an active stirring means, producing a randomly fluctuating, three-dimensional fluid flow field, rapidly mixing the solution to achieve homogeneity. (Paragraphs 0003, 0050; diffusion of liquids or solutes with different charges, conductivities or permittivities will inherently result in a random field as claimed)

Addressing claim 2, Ahn et al disclose a provided fluidic network (Figure 1) having a plurality of ports (20, 24, 28) including at least two inlet ports (20, 24) and one

outlet port (28), and a plurality of liquid channels connecting said plurality of ports (22). Ahn et al also disclose the introduction of small volume liquid streams into said fluidic network via said inlet ports (Paragraphs 0049 and 0087). These liquid streams are characterized as confluent, and they form the heterogeneous solution that is to be mixed. (Abstract)

Addressing claim 15, Ahn et al disclose the mixing of fluids containing biological macromolecules. (Paragraphs 0004 and 0006)

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. Claims 1, 2, 4, and 14 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Paul et al.

Addressing claim 1, Paul et al disclose an electrokinetic mixing method for rapid mixing (Column 2, line 19) of an initially heterogeneous solution (Column 3, lines 41-43) whose motion is dominated by viscous forces (Column 1, lines 27-34), said method comprising: inducing an electrokinetic flow instability with an AC electric field, essentially confined to a mixing chamber (110). (See Figure 1 and Column 2, line 58 - Column 3, line 20 for apparatus and flow description; AC field is described as usable in column 3, lines 21-25) This AC field acts as an active stirring means, producing a randomly fluctuating, three-dimensional fluid flow field, rapidly mixing the solution to achieve homogeneity. (Column 3, lines 15-20; diffusion is a random process, diffusion of liquids or solutes having different charges or permittivities will inherently lead to a field as claimed)

Addressing claim 2, Paul et al disclose a provided fluidic network (Figure 1) having a plurality of ports (A, B) including at least two inlet ports (A, B) and one outlet port (125), and a plurality of liquid channels connecting said plurality of ports (115, 120). Paul et al also disclose the introduction of small volume liquid streams into said fluidic network via said inlet ports (Claim 1, step b). These liquid streams are characterized as confluent, as they meet within chamber 110, and they form the heterogeneous solution that is to be mixed. (Claim 1, steps b and c)

Addressing claim 4, because liquids flow through the mixing chamber, it can be described as a channel, and the electrode configuration shown in Figure 1 would provide a field according to the limitations of this claim.

Addressing claim 14, Paul et al disclose the generation of a homogeneous solution from a fixed volume of heterogeneous solution without net flow. (Column 3, lines 27-32)

Since Paul et al teach all limitations of these claims, the reference is deemed to be anticipatory.

In addition, the presently claimed flow instability and fluid flow field would obviously be present once the method of Paul et al is performed. Note *In re Best*, 195 USPQ at 433, footnote 4 (CCPA 1977) as to the providing of this rejection under 35 U.S.C. §103 in addition to the rejection made above under 35 U.S.C. §102.

14. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Parce. (US 6,012,902)

Paul et al disclose a method as described above in addressing claim 2. Each pair of electrodes on the sides of the recirculation cells is used an electroosmotic pump. (Column 2, line 66 - Column 3, line 12)

Paul et al do not explicitly disclose positioning the electrodes through which the AC field is applied as claimed.

Parce et al disclose an electroosmotic pumping structure (Figure 2) wherein one electrode of the pump is placed at the end of a side channel that contains a flow-restrictive membrane as described in claim 6. (Column 8, line 16 - Column 9, line 2) Parce teaches the desirability of this structure in numerous circumstances. (Abstract, Column 3, lines 6-33)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Paul et al by replacing each of their pump structures (i.e. electrodes 130 and 140) with the structure of Parce (i.e. one electrode positioned in a side channel), because Parce teaches its usefulness in pumping operations, and a skilled artisan would recognize that it would reduce the potential for interference due to electrolytic gas generation, since at least some gases generated would be isolated from the mixing chamber.

15. Claims 8-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al in view of Arnold et al.

Ahn et al disclose methods as described above for claims 1 and 2. They also suggest the modification of the electric fields used in their method, including pulsed current and use of AC and DC. (Paragraph 0065)

Relevant to claim 8, Ahn et al further disclose continuous-flow mixing. (Paragraph 0087)

Ahn et al do not explicitly disclose the means used for fluid transport from the reservoirs to the outlet. (Claim 8) They also do not explicitly disclose the use of a steady DC field or pressure source for liquid stream advection in addition to the mixing AC electric field (Claim 9), incorporation of porous means as claimed in claim 10, pulse modulation between AC for mixing and DC for transport (Claim 11), or the addition of a steady DC component for transport simultaneous with the AC electric field (Claim 12).

Arnold et al teach methods whereby electrolytically produced gases are prevented from entering microchannel systems, including the use of specially designed pumps (Figures 2 and 3), for feeding liquids into microchannel systems, and the positioning of a porous dielectric medium in the pump channel. (Figure 2, medium 120) (Column 3, lines 22-36; Column 5, lines 18-23)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Ahn et al by providing fluid flow (i.e. from reservoirs 20 and 24 to outlet port 28) by using the electroosmotic pumps as taught by Arnold et al, because electroosmosis is known to be a convenient method of effecting fluid flow in microfluidic devices, and these pumps would eliminate gas bubble blockage

of the system (Arnold et al, Abstract), which would have been recognized by a skilled artisan as being highly advantageous.

The use of such electroosmotic transport, which is provided by a DC field, in conjunction with a steady or pulsed AC field, as taught by Ahn et al, meets the limitations of these claims.

16. Claims 8-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Arnold et al.

Paul et al disclose a method as described above for claims 1 and 2. They also suggest the modification of the electric fields used in their method, including oscillation and use of varying period. This suggests the use of alternating current. (Column 3, lines 21-25)

The reasoning for this rejection parallels that given in the preceding paragraph.

17. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al and Parce as applied to claim 5 above, and further in view of Arnold et al.

The reasoning for this rejection parallels that given above in paragraph 15.

18. Claims 8, 9, 11, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al in view of Manz et al.

Ahn et al disclose methods as described above for claims 1 and 2. They also suggest the modification of the electric fields used in their method, including pulsed current and use of AC and DC. (Paragraph 0065)

Relevant to claim 8, Ahn et al further disclose continuous-flow mixing. (Paragraph 0087)

Ahn et al do not explicitly disclose the means used for fluid transport from the reservoirs to the outlet. (Claim 8) They also do not explicitly disclose the use of a steady DC field or pressure source for liquid stream advection in addition to the mixing AC electric field (Claim 9), pulse modulation between AC for mixing and DC for transport (Claim 11), or the addition of a steady DC component for transport simultaneous with the AC electric field (Claim 12).

Manz et al teach the effectiveness of electroosmotic fluid transport in microfluidic systems, by establishing a DC potential between source and destination reservoirs. (Abstract, Section 1.4)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Ahn et al by providing fluid flow (i.e. from reservoirs 20 and 24 to outlet port 28) by using electroosmotic pumping as taught by Manz et al, because they teach that electroosmosis is a convenient, efficient method of effecting fluid flow in microfluidic devices, and it would eliminate the need for more complicated pumping systems.

The use of such electroosmotic transport, which is provided by a DC field, in conjunction with a steady or pulsed AC field, as taught by Ahn et al, meets the limitations of these claims.

19. Claims 8, 9, 11, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Manz et al.

The reasoning for this rejection parallels that given in the preceding paragraph.

20. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al.

Ahn et al disclose a method as described above for claim 1. They also disclose the use of porous dielectric membranes within the channels. (Paragraph 0054) These membranes (or filters) are disclosed as preventing passage of interfering materials (Paragraph 0054). Numerous disclosed materials would not interfere with passage of the AC field, and the combination of their porosity with the use of electrolyte fluids (Abstract) renders them conductive.

Ahn et al do not explicitly disclose the use of high flow resistance in the membranes they use.

It would have been obvious to one of ordinary skill in the art to modify the method of Ahn et al by replacing their membranes with membranes of high flow resistance, because it could be required by the demands of a particular research problem.

21. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al in view of Wilding et al.

Ahn et al disclose a method as described above for claim 1.

Ahn et al do not explicitly disclose the means used to achieve fluid flow from inlet to outlet.

Wilding et al disclose the use of a pressure-based micropump to effect fluid motion in their capillary system. (Figure 4; Column 9, lines 38-42)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Ahn et al by using a pressure-based micropump to provide fluid flow, as taught by Wilding et al, because it would prevent possible electrical interference or electrolysis due to application of a DC field.

22. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Wilding et al.

The reasoning for this rejection parallels that given in the preceding paragraph.

23. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al in view of Yager et al.

Ahn et al disclose a method as described above for claim 1. They also suggest the use of various sensors to monitor performance of their system. (Paragraph 0055)

Ahn et al do not explicitly disclose the use of means for analysis of mixing performance.

Yager et al disclose the monitoring of mixing efficiency in their microfabricated system. (Figure 2; Column 7, lines 1-6)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Ahn et al by including a sensor to monitor mixing efficiency, as taught by Yager et al, because it was suggested by Ahn et al, and would allow for precise optimization of operating parameters.

24. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Yager et al.

Paul et al disclose a method as described above for claim 1.

Paul et al do not explicitly disclose the use of means for analysis of mixing performance.

Yager et al disclose the monitoring of mixing efficiency in their microfabricated system. (Figure 2; Column 7, lines 1-6)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Paul et al by including a sensor to monitor mixing efficiency, as taught by Yager et al, because it would allow for precise optimization of operating parameters.

25. Claims 17-24, 26, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al in view of Arnold et al.

Relevant to claim 17, Ahn et al disclose a micromixer, comprising a fluidic network (Figure 1) having: a mixing chamber, characterized as the channel lying between the electrodes used to apply the AC field (Figures 3-7); a plurality of ports (20, 24, 28) including at least two inlet ports (20, 24), two side channel ports (24), an outlet port (28), and a plurality of liquid channels connecting the mixing chamber and plurality of ports (22); and one or more porous dielectric membranes. (Paragraph 0054) Whether these membranes have high flow resistance would be a matter of selection based on the particular application. Ahn also discloses the use of an AC electric field across the mixing chamber to effect mixing of a heterogeneous solution, rendering it homogeneous. (Paragraph 0050)

Relevant to claim 18, Ahn et al disclose electrically conductive buffer positioned in the side channel ports (24) (Paragraphs 0052, 0055, and 0056)

Relevant to claim 20, Ahn et al disclose modulation (pulsing) of AC and DC fields, implicitly including means of causing such modulation. (Paragraphs 0063-0065)

Relevant to claim 22, Ahn et al disclose a continuous mixing mode. (Paragraph 0087)

Relevant to claim 26, Ahn et al disclose the mixing of a solution containing biological macromolecules (Paragraph 0004)

Relevant to claim 28, Ahn et al disclose a micromixer with no moving parts (Paragraph 0009), utilized in a bioanalytical system. (Paragraph 0004)

Ahn et al do not explicitly disclose the positioning of electrodes at the ends of side channels (Claim 17). Nor do they disclose the use of DC-driven electroosmotic

flow of fluids from inlet to outlet (Claims 20-22) or pressure-based fluid flow. (Claims 23 and 24)

Arnold et al teach methods and devices wherein electrolytically-produced gases are prevented from entering microchannel systems, including the use of specially-designed pumps (Figures 2 and 3), for feeding liquids into microchannel systems, and the positioning of a porous dielectric medium (i.e. membrane) in the pump channel. (Figure 2, medium 120) (Column 3, lines 22-36; Column 5, lines 18-23)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Ahn et al by providing fluid flow (i.e. from reservoirs 20 and 24 to outlet port 28) by using the electroosmotic pumps as taught by Arnold et al, because electroosmosis is known to be a convenient method of effecting fluid flow in microfluidic devices, and these pumps would eliminate gas bubble blockage of the system (Arnold et al, Abstract), which would have been recognized by a skilled artisan as being highly advantageous.

The use of such electroosmotic transport, which is provided by a DC field, in conjunction with a steady or pulsed AC field, as taught by Ahn et al, meets the limitations of claims 20-22.

Additionally, the pump of Arnold et al provides a fluid flow pressure in the downstream channels and can be called a "micropump, given the channel dimensions, meeting the limitations of claims 23 and 24.

In this rejection, undue weight is not given to recitations of intended use of the structure defined within the claim. (e.g. lines 9-12 of claim 17) The combination

provided meets all structural limitations; as electrodes at the end of the side channels are necessary in the pumping structure of Arnold et al. Although application of an AC field is recited in the claim, there is no structural limitation to a voltage source that applies the AC field via the side channel ports. A recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

26. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al and Arnold et al as applied to claim 17 above, and further in view of Paul et al.

Ahn et al and Arnold et al disclose a combination as described above for claim 17.

Neither Ahn et al nor Arnold et al explicitly disclose mixing with stopped fluid flow.

Paul et al disclose the use of a microfluidic mixer to mix fluids in the absence of net fluid flow. (Column 3, lines 27-32)

It would have been obvious to one of ordinary skill in the art at the time of the invention to further modify the combination of Ahn et al and Arnold et al by stopping the bulk flow of liquid into and out of the mixing chamber during mixing, as taught by Paul et al, because it would allow for more thorough mixing prior to discharge of the solution.

27. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ahn et al and Arnold et al as applied to claim 17 above, and further in view of Yager et al.

Ahn et al and Arnold et al disclose a combination as described above for claim 17. Ahn et al also suggest the use of various sensors to monitor performance of their system. (Paragraph 0055)

Neither Ahn et al nor Arnold et al explicitly disclose the use of means for analysis of mixing performance.

Yager et al disclose the monitoring of mixing efficiency in their microfabricated system. (Figure 2; Column 7, lines 1-6)

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combination of Ahn et al and Arnold et al by including a sensor to monitor mixing efficiency, as taught by Yager et al, because it was suggested by Ahn et al, and would allow for precise optimization of operating parameters.

28. Claims 17-19, 25, 26, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al in view of Parce.

Paul et al disclose a micromixer comprising a mixing chamber, two inlet ports, and an outlet port with associated channels. Each pair of electrodes on the sides of the recirculation cells is used an electroosmotic pump. (Column 2, line 66 - Column 3, line 12)

Regarding claim 18, electrodes are positioned in the side channels, which would be used to apply the field.

Regarding claim 19, it would have been obvious to externally mount the membranes, to facilitate cleaning and/or replacement.

Regarding claim 25, Paul et al disclose the generation of a homogeneous solution from a fixed volume of heterogeneous solution without net flow. (Column 3, lines 27-32)

Paul et al do not explicitly disclose the high flow resistance membranes, the side channel ports, or positioning the electrodes through which the AC field is applied as would be required to carry out the intended use of the device as claimed.

Parce et al disclose an electroosmotic pumping structure (Figure 2) wherein one electrode of the pump is placed at the end of a side channel that contains a flow-restrictive membrane as claimed. (Column 8, line 16 - Column 9, line 2) Parce teaches the desirability of this structure in numerous circumstances. (Abstract, Column 3, lines 6-33)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the device of Paul et al by replacing each of their pump structures (i.e. electrodes 130 and 140) with the structure of Parce (i.e. one electrode positioned in a side channel), because Parce teaches its usefulness in pumping operations, and a skilled artisan would recognize that it would reduce the potential for interference due to electrolytic gas generation, since at least some gases generated would be isolated from the mixing chamber. Such a structure meets all instant claim limitations.

Regarding claims 26 and 28, Paul et al are silent concerning materials contained in the fluids to be mixed, but one having ordinary skill in the art would have realized that it could be used for any electroosmotically-pumpable fluid, including those containing large solutes that would have low diffusivity, including biological analytes. The device is formed on a single chip, and if used to mix fluids in a bioanalytical procedure, the limitations of claim 28 will be met.

29. Claims 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al and Parce as applied to claim 17 above, and further in view of Manz et al.

Paul et al and Parce disclose a combination as described above in addressing claim 17.

Neither Paul et al nor Parce explicitly disclose the flow means by which the fluids are introduced to the mixing chamber.

Manz et al teach the effectiveness of electroosmotic fluid transport in microfluidic systems, by establishing a DC potential between source and destination reservoirs. (Abstract, Section 1.4)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Paul et al by providing fluid flow (i.e. from inlets 115 and 120) by using electroosmotic pumping as taught by Manz et al, because they teach that electroosmosis is a convenient, efficient method of effecting fluid flow in microfluidic devices, and it would eliminate the need for more complicated pumping systems.

The use of such electroosmotic transport, which is provided by a DC field, in conjunction with an AC field, as taught by Paul et al, meets the limitations of these claims.

30. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Paul et al and Parce as applied to claim 17 above, and further in view of Yager et al.

The reasoning for this rejection parallels that given above in paragraph 27.

Allowable Subject Matter

31. Claim 3 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

32. The following is a statement of reasons for the indication of allowable subject matter: Claim 3 includes method limitations to the application of an AC electric field through electrodes positioned at channel ends that also serve as fluid inlets and outlets. Neither Ahn et al nor Paul et al disclose or suggest such a step, nor was any teaching found in the prior art to suggest such modification. Additionally, Ahn et al teach away from such remote positioning of the mixing electrodes (Paragraph 0062)

Response to Arguments

33. Applicant's arguments filed on 19 September 2005 have been fully considered but they are not persuasive.

Regarding the rejections under 35 U.S.C. §102, Applicants give detailed arguments highlighting the differences between the operating principle of their mixer and those of Ahn et al and Paul et al. It appears that Applicants are relying on a narrow definition of "electrokinetic flow instability", which appears not to be justified based on the specification. No clear, unambiguous definition for "electrokinetic flow instability" is given in the specification, therefore the broadest reasonable definition should be used. The Examiner considers any physical nonuniformity in a flow pattern caused by an electric field to read on the instantly claimed "electrokinetic flow instability". Therefore, Ahn et al and Paul et al anticipate claim 1 as currently recited. Although their systems might not be the same as the micromixer of the instant application, distinctions must be clear in the language of the claims.

Applicant's arguments regarding the rejections under 35 U.S.C. §103 relying on Bek as a teaching reference are persuasive, but are largely moot in light of the new bases for rejection presented above.

Conclusion

34. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Jeffrey Barton, whose telephone number is (571)

272-1307. The examiner can normally be reached Monday-Friday from 8:30 am – 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen, can be reached at (571) 272-1342. The fax number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at (866) 217-9197 (toll-free).

JTB
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